

APPLICATION OF GOAL PROGRAMMING MODEL FOR BUDGETING IN RIVERS STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY , PORT HARCOURT.

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ABSTRACT:

The purpose of this study is to apply goal programming model for budgeting in Rivers State University of Science and Technology, Port Harcourt. The aspiration of this work is to increase or decrease the amount budgeted to five(5) different objectives (goals), these are personnel cost, overhead cost, capital expenditure, revenue (internal generated) and total budget. The simplex method (Big M) was used to solve the weights goal programming model formulated for the collected data. The application of the simplex method by TORA package gives the following results in billion Naira as: the optimum solution is $Z = 16.55$, $X_1 = X_2 = 0$, $X_3 = 4.06$, $d_1 = 2.02$, $d_2 = 1.70$, $d_3 = 0.25$, $d_4 = 3.57$ and $d_5 = 0$.

Based on the results obtained it was found that the optimum value ($Z = 16.55$) satisfied all the goals except goal 4 which is revenue goal.

KEYWORDS: Annual budget; Aspiration level; Budget document, Multiple goals; Optimum result, Personnel cost.

INTRODUCTION

Budgeting is a complicated task that requires cooperation among functional units in any higher institution. It is an important area in the administrative setting of any university. It is a detailed plan indicating the activities which a unit, department or the entire university intended to carry out at a particular time in future.

Budget document goes beyond mere plan, therefore, it could be said that all budgets are plans but plans are not budget. Budget is a financial tool used in gathering information Duncan (1996).

According to Duncan (1996) a budget is a plan expressed in quantitative and money terms and it can include some or all income, expenditure, and the capital to be employed. The aim of this study is to increase or reduce the amount of money budgeted or allocated to five (5) different objectives (goals): Personal cost, overhead cost, capital expenditure, revenue and total budget in Rivers State University of Science and Technology, Port Harcourt.

In order to formulate (design) an effective budgeting model, a good understanding of the institution budgeting processes is a must. Although, such budgeting model exists in the university, it is not properly structured due to the presence of multiple objectives (goals). A formal decision analysis that is capable of handling multiple goals through the use of priorities is the goal programming model.

Goal programming is an extension of linear programming (LP) which is a mathematical tool to handle multiple objectives. Ignizio (1978); affirmed that goal programming is a relatively new tool that has been proposed as a model and approach for the analysis of problem involving multiple objectives.

The basic approach of goal programming (GP) is to establish a specific numeric goal for each of the objectives, formulate an objective function for each objective and seek a solution that minimizes the (weighted) sum of deviation of the objective functions from their respective goals.

Dade (1981), designed a goal programming model and used it for revenue budgeting. He pointed out that the concern with the process and of budgeting has regulated the revenue constraint to a position co-equal with variable

Taha (2003); said that goal programming technique is for solving multiple objective models and the aim is to convert the original objective into a single goal.

Chowderly and slomp (2002); considered goal programming as an appropriate, powerful and flexible technique for decision analysis of the troubled modern decision maker who is burdened with achieving multiple objectives under complex environmental constraints.

Winston (1994); defined Goal programming as the technique used to choose among alternatives.

Sundaram (1978); affirmed that goal programming combines the logic of optimization in Mathematical programming with the decision makers desire to satisfy several goals.

Du, Acharya and Sahu (1982); developed a goal programming model and applied it for budgeting in the production area, they considered the following constraint as a mathematical programming model;

$$\sum a_{ij} x_j \leq b_i, \quad (i = 1, 2, 3, \dots m. \quad j = 1, 2, 3 \dots n)$$

X_j are decision variables

a_{ij} are the decision variable coefficients.

b_i are the right hand side elements.

Brief History Of The Institution

Rivers State University of Science and Technology, Port Harcourt, is the premier University of Science and Technology in Nigeria. The Institution was formerly known as Rivers State College of Science and Technology and was upgraded to University by the Rivers State Government in the year 1980.

Currently, the University has seven Faculties, Forty-Three Departments. Four Institutes, a Post Graduate School, standard library and Medical Sciences Department. There are Administrative Blocks. Exams and Record Office. Admissions Office and the Bursary Department.

The Bursary consist of Audit Unit, Student Accounts unit and Staff Salary and Emoluments Unit.

The Institution is financed by the Rivers State Government. It is also funded from donations by Corporate bodies and individuals.

This study is determine by the annual budget requirements unat can help in planning for the future and development of the institution.

MATERIALS AND METHODS

The purpose of this study is to applied goal programming model for budgeting in Rivers State University of Science and Technology, Port Harcourt.

The data for this study were previous budgets of the University from 2008 - 2010, collected from Rivers State Ministry of Finance, Port Harcourt.

The weighted goal programming model is of the form:

$$\text{Minimize } Z = \sum_{i \in m} (W_i^+ d_i^+ + \bar{W}_i^- d_i^-).$$

Subject to :

$$\sum_{j=1}^n (a_{ij} x_j + d_i^- - d_i^+) = b_i$$

} 2.1

$d_i, d_i, x_j \geq 0$. ($i = 1, 2, 3, \dots, m$ $j = 1, 2, 3 \dots n$)

Where d_i and d_i = deviational Variables.

X_j = decision variables.

a_{ij} = decision variable coefficients.

W_i and W_i = non-negative constraints representing relative weights.

PRESENTATION AND ANALYSIS OF DATA.

The data (previous budgets) collected in billion Naira are shown in Table 1

TABLE 1: The data (previous budgets) collected in billion Naira

ITEM	Amount Budgeted in Billion Naira / year			Total
	2008	2009	2010	
Personnel cost	0.982	1.009	1.361	3.352
Overhead cost	0.065	0.068	0.073	0.206
Capital expenditure	0.025	0.614	0.432	1.071
Revenue (Internal generated)	1.105	0.2	0.6	0.905
Total Budget	1.178	1.891	2.465	5.534

Source: from Rivers State Ministry of Finance, Port Harcourt.

The budget of the University from 2008 - 2010 and the assigned weights are shown in Table 2.

TABLE 2: The budget of the University from 2008 - 2010

ITEM	Amount Budgeted in Billion Naira / year			Total	Assigned weights W_i
	2008	2009	2010		
Personnel cost	0.982	1.009	1.361	3.352	6
Overhead cost	0.065	0.068	0.073	0.206	2
Capital expenditure	0.025	0.614	0.432	1.071	4
Revenue (Internal generated)	1.105	0.2	0.6	0.905	10
Total Budget	1.178	1.891	2.465	5.534	8

The Weights were chosen regarding the relative importance of each goal. The determination of the specific values of the weights is subjective.

Aspiration Level (Target value) of the Goals

The goals statements of the budget of the institution are;

Goal 1: Raise personnel cost (salary and allowances of staff) by at least N 3.5 billion per annum.

Goal 2: Reduce overhead cost by at most N 2 billion per annum.

Goal 3: Raise capital expenditure by at least N1.5 billion per annum.

Goal 4: Raise revenue (internal generated) by at least N6billion per annum

Goal 5: Reduce the total budget by at most N10 billion per annum.

The determination of the target values is subjective. Anyone can use values different from the above used values and obtains different solution.

The Goal programming model formulation.

Let X_1 = amount budgeted for the period 2008.

Let X_2 = amount budgeted for the period 2009.

Let X_3 = amount budgeted for the period 2010.

The goals can be stated mathematical as follows:

$$\begin{aligned} 0.982X_1 + 1.009X_2 + 1.361X_3 &\geq 3.5 \text{ (personnel cost constraint)} \\ 0.065X_1 + 0.068X_2 + 0.073X_3 &\leq 2 \text{ (overhead cost constraint)} \\ 0.025X_1 + 0.614X_2 + 0.432X_3 &\geq 1.5 \text{ (capital expenditure constraint)} \\ 0.105X_1 + 0.2X_2 + 0.6X_3 &\geq 6 \text{ (Revenue constraint)} \\ 1.178X_1 + 1.891X_2 + 2.465X_3 &\leq 10 \text{ (Budget Constraint)} \\ X_1, X_2, X_3 &\geq 0 \end{aligned}$$

Conversion of Goal Programming Model to Linear Programming Model

Let d_i^+ = amount by which we numerically exceed the goal.

Let d_i^- = amount by which we numerically under the goal

d_i^+ and d_i^- are referred to as deviational variables.

Let Z be the-sum of deviation from the goals.

Applying the weighted goal programming model, the goal programming formulation can be stated mathematically as follows:

$$\text{Minimize } Z = 6d_1^+ + 2d_2^- + 4d_3^+ + 10d_4^+ + 8d_5^- \text{ (objective function)} \quad (1)$$

Subject to :

$$0.982x_1 + 1.009X_2 + 1.361X_3 + d_1^+ - d_1^- = 3.5 \quad (2)$$

$$0.065X_1 + 0.068X_2 + 0.073X_3 + d_2^- - d_2^+ = 2 \quad (3)$$

$$0.025X_1 + 0.614X_2 + 0.432X_3 + d_3^- - d_3^+ = 1.5 \quad (4)$$

$$0.105X_1 + 0.2X_2 + 0.6X_3 + d_4^- - d_4^+ = 6 \quad (5)$$

$$1.178X_1 + 1.891X_2 + 2.465X_3 + d_5^- - d_5^+ = 10 \quad (6)$$

$$X_1, X_2, X_3, d_1^+, d_1^-, d_2^+, d_2^-, d_3^+, d_3^-, d_4^+, d_4^-, d_5^+, d_5^- \geq 0.$$

The application of the simplex Method (M. Method) by Tora package in solving the linear programming model formulated gives the optimum solution below;

RESULTS AND DISCUSSION

Title: goal programming .

Final iteration No. 8

Objective Value = 16 . 55

Variable	Value	Obj Coeff	Obj Val Contrib
x_1 :	0.00	0.00	0.00
x_2 :	0.00	0.00	0.00
x_3 :	4.06	0.00	0.00
d_1+	2.02	6.00	12.13
d_2+	0.00	0.00	0.00
d_3+	0.25	4.00	1.01
d_4+	0.00	10.00	0.00
d_5+	0.00	0.00	0.00
d_1-	0.00	0.00	0.00
d_2-	1.70	2.00	3.41
d_3-	0.00	0.00	0.00
d_4-	3.57	0.00	0.00
d_5-	0.00	8.00	0.00

The optimum result (value) is $Z = 16.55$, since it is not equal to zero. This implies that at least one of the goal is not met. The optimum value satisfied all the goal except goal 4 which is the revenue goals.

The deviational value from the personnel cost goal is $d_1 = 2.02$, this means that the personnel cost goal target of N3.5 billion is below the personnel cost goal by 2.02. that is the actual amount that should be budgeted for personnel cost is 5.07. The deviational value from the overhead cost goal is $d_2 = 1.70$, this means that the overhead cost goal target of 2.00 exceeded the overhead cost goal by 1.70. That is , the actual amount that should be budgeted for overhead cost is, 0.3.

The deviational value from the capital expenditure goal is $d_3 = 0.25$, this implies that the capital expenditure goal target of 1.5 is below the capital expenditure goal by 0.25. That is the actual amount that should be budgeted for capital expenditure is 1.75. The deviational value from the revenue (internal generated) goal is $d_4 = 3.57$, this implies that the revenue goal target of 6 is exceeded by 3.57. That is, the actual amount that should be budgeted for revenue is 2.43, conversely, the budget goal of the university of at most 10, billion naira target is not violated because $d_5 = 0$. Therefore the minimum budget of the university is 16.55 in 2011.

CONCLUSION.

In this study, the goal programming model formulated for the collected data from 2008 - 2010, was converted to linear programming model. The simplex method (Big M) was used to solve the linear programming model formulated

The application of the simplex method (M Method) by Tora package gives the optimum result as $Z = 16.55$ billion Naira. Based on the result obtained, It was found that the optimum result satisfied all the goals except goal 4 which is the revenue goals. The deviational value from the revenue goal is 3.57 billion Naira. That is , the actual revenue goal should be 2.43 billion Naira. Since the optimum result is $Z = 16.55$ billion Naira, therefore, the budget of the Institution should be 16.55 billion Naira and this amount should cover all their needs.

RECOMMENDATIONS

On the basis of the finding of this study, the following recommendations are made:

1. The state Government should fund the institution adequately.
2. Budgeting should base on new technology.
3. The budget should be properly managed and utilized by the institution.
4. Timely and active budget monitoring team of the state Government should monitor the budget.
5. Further research on this study should be carried out.

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